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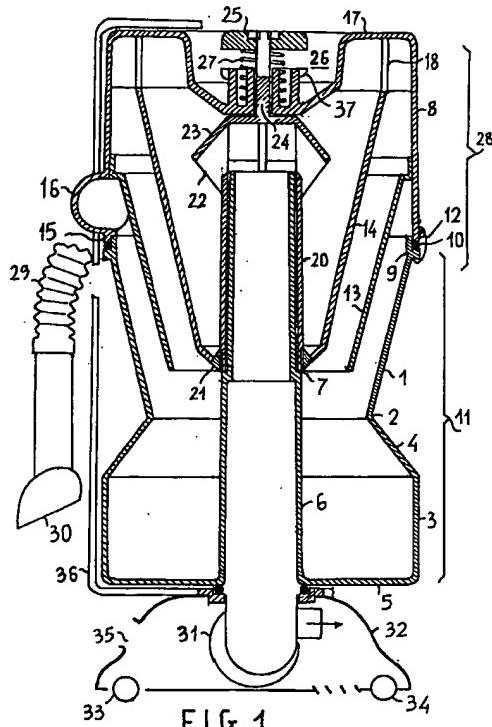
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(54) A household vacuum cleaner

(57) A double-cyclone domestic vacuum cleaner in which a first cyclone (1), separable from a coaxial second cyclone (14) inside the said first cyclone, collects the coarser particulate material and deposits it in a first container (3) and the said second cyclone collects the finer dust, the first container and the first and second cyclones being transversed by an axial suction duct (6) which connects the top of the second cyclone (14) with suction means (31).

The second cyclone has an axial sleeve (20) which engages the axial suction duct (6) and forms at the bottom of the second cyclone a toroidal dust collection chamber, which can be opened by moving the sleeve (20) and the second cyclone (14) relative to each other for disposing of the dust.

Alternatively, the toroidal chamber may house a disposable capsule (43, 48) for collecting and storing dust, which is inserted through an openable lid (44) on the second cyclone (14) which can be sealed, before being removed, without needing to open the lid (44).



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Description

The present invention relates to a double-cyclone vacuum cleaner with independent chambers, which can be emptied separately, for collecting dust from the first and second cyclones.

It is known that, for household cleaning, vacuum cleaners are used in which the flow of dusty air, drawn by a motor/suction fan assembly, passes through a bag which filters and collects the dust and cleans the air.

In order for the vacuum cleaner to work it is necessary to replace the bag periodically (vacuum cleaners with a filter which must be periodically cleaned have been phased out) and the more frequently the bag is replaced the more efficiently the cleaner will operate. The replacement causes serious inconvenience to the user.

The handling required to remove and replace the dirty dust bag is a source of dust.

A further disadvantage of such vacuum cleaners is that the greater the degree of filtering and the finer the dust they are able to filter, the more power they use because the dust bag itself constitutes an obstruction to the air flow, causing a significant pressure drop which becomes worse as the dust accumulates in the bag and clogs it.

In order to achieve greater and more constant efficiency and to capture even very fine dust, which is often the cause of allergies, cyclone vacuum cleaners for domestic use have come on the market, in which a centrifugal effect makes it possible to separate dust and other particles of greater dimensions and density with a minimum pressure drop while a filter bag downstream is responsible for collecting the finer particles.

Solid particles of larger dimensions are accumulated in a chamber which can be periodically emptied.

In an additional development, vacuum cleaners have been proposed with two cyclones in cascade, a first cyclone serving to capture the particles of larger dimensions and a second carrying out a further filtering.

Examples of such an arrangement are described in European Publications EP-A-0018197, EP-A-0489565 and EP-A-0042723.

In this case two collection chambers are provided which, though independent, must be emptied at the same time.

This operation involves the same problems for the user as those caused by vacuum cleaners with dust bags: dust dispersal, risk of getting dirty and potential development of allergic reactions, and in any case this always leads to some dust dispersal.

In order to reduce these disadvantages, it has also been proposed, as for example in patents EP-A-0489468 and GB-A-2249272, that these double-cyclone vacuum cleaners be provided with a bag for collecting the particles and dust, which is housed in a single chamber fixed to the vacuum cleaner, and divided into two compartments by a removable diaphragm.

By opening the chamber and thereby removing the diaphragm it is possible to remove the bag from the vacuum cleaner with the dust and other particles contained in it.

However, this removal of the diaphragm, as a result of opening the chamber, once again involves the dispersal of dust with the aforesaid problems this involves.

This is essentially due to the fact that the diaphragm is in direct contact with the dust, which is agitated and mixes with the coarser particles.

These problems arise each time it is necessary to open the chamber, that is each time even one of the two compartments is full and needs to be emptied.

Since it is usually the compartment containing the coarser particles which fills the fastest, each time this needs to be emptied the user is unfortunately exposed to the dispersal of fine dust which it would be desirable to avoid.

A further disadvantage of double-cyclone vacuum cleaners is constituted by the fact that in order to make the machine reasonably compact, the two cyclones are generally arranged coaxially, one inside the other, and the output flow to the suction motor unit from the top of the second cyclone has to be conveyed through an annular duct passing around the two cyclones and to the suction motor unit which, for reasons of stability but also for operational reasons (it often has to drive rotating brushes) is generally arranged below the cyclones, in a head with wheels for moving around the floor.

This involves a larger size, not inconsiderable pressure drops in the duct, and finally the use of a high power suction motor unit which has a high energy consumption.

Vacuum cleaners are also known in which the duct between the output of the second cyclone and the suction unit is essentially cylindrical and thus causes a smaller pressure drop, arranged to one side of the two cyclones, but this, too, makes the machine bigger, which should be avoided.

The present invention solves these problems and satisfies the aforesaid requirements by providing a domestic double-cyclone vacuum cleaner which is highly efficient, compact, of limited suction power used efficiently in the cyclones, which allows the two collection chambers to be emptied separately, in particular allowing the chamber for coarser particles to be emptied without needing to open the chamber for fine dust. Essentially, the two cyclones of the vacuum cleaner constitute two independent units which are easily separable from each other, such separation making it possible to empty the chamber for coarser particles without needing to open and empty the chamber for fine dust, this latter operation requiring a closure cap to be removed from the chamber.

In addition, the suction duct linking the second cyclone for collecting finer dust to the suction motor unit is constituted by a cylindrical tube coaxial with the two cyclones and passing through them so that the vacuum

cleaner is more compact and any pressure drop in the duct is kept to a minimum.

Furthermore, this arrangement ensures that the suction duct is perfectly airtight, which is otherwise very difficult to achieve.

An additional advantage is that the suction duct acts as a centring pin for the user to fit the two cyclones together, ensuring that they are easy to separate and fit back together.

According to a further aspect of the present invention, the vacuum cleaner is conveniently fitted with a disposable capsule, removably housed in the chamber for fine particles, which collects the fine dust, and with means for closing and sealing this capsule without opening the chamber, whereby when it is next necessary to open the chamber to remove the capsule, this can be done without any dispersal of dust.

It is possible, though not essential, to provide a similar capsule for storing the coarser particles, this would be closed manually after opening the appropriate chamber since, in this case, the risk of dispersing fine dust while manipulating the chamber is negligible.

The characteristics and advantages of the invention will become clearer from the following description of a preferred embodiment of the invention and of some variants thereof, with reference to the appended drawings, in which:

Figure 1 is a diametral section of a preferred embodiment of a vacuum cleaner according to the present invention;

Figure 2 is a perspective view of a structural element of the vacuum cleaner of Figure 1;

Figure 3 is a partial diametral section of a first variant of the vacuum cleaner of Figure 1;

Figure 4 is a diametrical section of a second variant of the vacuum cleaner of Figure 1, modified to use a replaceable, disposable capsule for collecting and storing dust, and the associated sealable capsule;

Figure 5 is a diametral section of a variant of the vacuum cleaner of Figure 4 and the associated sealable capsule; and

Figure 6 is a diametral section of a third variant of the vacuum cleaner of Figure 1.

With reference to Figure 1, a double-cyclone vacuum cleaner according to the present invention essentially comprises a first hollow frusto-conical body 1 with a lower end 2, having a smaller diameter, fixed to a generally cylindrical container 3 with a converging collar 4 and a generally flat bottom 5.

A generally cylindrical (in reality slightly conical so as to facilitate the moulding operation) duct 6 extends coaxially through the container 3 and the frusto-conical body 1 and, conveniently, has a step halfway along forming an external annular shoulder 7, the purpose of which will be explained later.

The frusto-conical body 1, the container 3, the bot-

tom 5 and the duct 6 can easily be moulded from plastics material as a unit, indicated hereinafter as the lower element 11.

The frusto-conical body 1 is closed at the top by a cap 8, generally shaped like an inverted cylindrical cup, also moulded from plastics material and attached to the appropriately shaped upper rim 9 of the frusto-conical body 1, with the interposition of a seal 10.

The removable connection between the cap 8 and the lower element 11 is secured by suitable clip means 12 of conventional type.

A first funnel-shape element 13, extending inside the frusto-conical body 1, and a second funnel-shape element 14, extending inside the first, are fixed inside the cap 8 by heat-welding, gluing or simply as a pressure fit.

Near its rim 15, the cap 8 has an inlet aperture 16 for the tangential entry of air into the frusto-conical annular space formed between the body 1 and the funnel-shape element 13, which closes the top of this annular space.

The top of the funnel-shape element 14, which is fixed to the top 17 of the cap 8, has in turn apertures 18 for admitting air into the funnel-shape element 14.

In addition, as shown in the perspective view of Figure 2, the funnel-shape element 14 also has helical ribs 19, 119 for guiding the air entering it and imparting to it a vortex motion tangential to the walls of the element 14 itself.

The bottom end of the funnel 14 is closed by a generally cylindrical sleeve 20, housed within the funnel.

The sleeve 20 is freely engaged on the duct 6, with its bottom end resting on the abutment 7.

In order to ensure a perfect seal between the bottom end of the funnel 14 and the sleeve 20, the bottom end of the latter is conveniently fitted with an upwardly tapering collar 21, possibly made of resilient material, which mates with the lower end of the funnel.

The cylindrical sleeve 20 is connected at the top, by means of a set of arms 22, to a generally hemispherical cap 23 with a vertical rod 24 passing slidably through the top wall 17 of the cap 8 and ending in a push-button 25 outside the cap 8.

A recess 26 is conveniently formed in the top wall 17 to house the push-button 25 and to limit the downward travel thereof to a predetermined stroke.

A compression spring 27 between the push-button and the upper wall 17 ensures in its rest position that the lower aperture of the funnel 14 is closed.

The assembly comprising the cap 8, the funnel 13, the funnel 14 and the sleeve 20 with the rod 24 and push-button 25 constitutes an upper assembly, generally indicated 28, of the filtering system of the vacuum cleaner, which is removably connected to the lower element 11.

The vacuum cleaner is completed by per se conventional elements such as a flexible suction hose 29 which is connectable to the suction aperture 16 and

ends in a suction tool 30, possibly interchangeable with a set of different tools, a suction motor assembly 31, sealingly connected with or without an interposed auxiliary filter, perhaps of activated carbon, to the end of the duct 6, and possibly housed in a movable base 32 with wheels 33, 34 and an aperture 35 for possible connection to the suction duct 29 input and, finally, a framework 36 for removably containing the filtering system formed by the upper assembly 28 and the lower element 11.

It is therefore clear that the filtering system is particularly suited for application either as a portable "backpack" vacuum cleaner, as described for example in European publication EP-A-0557096, or as a floor-standing vacuum cleaner.

The operation of a vacuum cleaner with a filtering system as described is known in itself: the air drawn in through the inlet aperture 16 tangentially enters the cyclone formed by the frusto-conical element 1, deposits most of the solid particles it is carrying into the container 3 and, thus cleansed, rises into the space formed between the funnel 13 and the funnel 14 to flow out of the top of the funnel 14.

Here, deflected by the ribs 19 and by the top of the cap 18 it takes on a vortex motion with a component of the stream travelling downwards whereby the residual particles (very fine dust), on contact with the inner surface of the cyclone formed by the funnel 14, is braked and deposited by gravity on the bottom of the cyclone, while the clean air rises, flowing in the opposite direction towards the cap 23, and is drawn out through the duct 6.

It is very simple to empty both the container 3 and the cyclone formed by the funnel 14, which also acts as container for the finest dust.

After having removed the filtering system from the suction motor unit 31 and the containment structure 36 (if present), the lower element 11 is separated from the upper assembly 28 by releasing the clip devices 12 and sliding the funnel 14 and the sleeve 20 from the duct 6.

The lower element can then be carried entirely safely as it is only partly full of solid particles and upturned and emptied into a bin.

Alternatively, a refuse sack can be fitted over the element which is then inverted thus emptying the contents of the container 3 into the sack.

The presence of the open central duct 6 provides a pressure compensation aperture and helps to avoid puffs of air should the user want to pack down the bin liner and close it before removing it from the lower element 11.

This prevents any dispersal of dust into the environment.

The operation for emptying the container 3 is thus entirely separate from that for emptying the cyclone 14, the discharge of which remains closed by the sleeve 20 and the associated sealing ring 21.

In order to empty the cyclone 14 which contains the finer dust it is possible to carry the upper assembly 28 totally safely to the disposal point and then to open the

bottom discharge of the cyclone 14 by pressing on the button 25.

In order to facilitate this operation, the upper cap 8 may have projections 37 in the recess 26 which make it easier to achieve the right pressure on the button 25.

In order to prevent any dispersal of dust, it is possible also in the case of the upper assembly 28 to fit a refuse sack over the bottom of the funnel 13 before pressing the button 25, emptying the cyclone 14 and removing the sack.

The filtering system thus proves to be particularly efficient and effort-saving, enabling the container 3 and the cyclone 14 to be emptied separately, even at different times, as frequently as in actually required and with no risk of dispersing dust.

It should be noted, incidentally, that when the lower element 11 and the upper assembly 28 are coupled together, the abutment 7 prevents any accidental opening of the cyclone 14 and thus any spillage of dust from the cyclone 14 to the container 3.

Numerous variants of the embodiment of Figures 1 and 2 are possible.

For example, in Figure 3 there is shown a diametral section of the upper unit of a double cyclone vacuum cleaner which differs from that of Figures 1 and 2 by the fact that the upper unit 28 has a cylindrical sleeve 20 fitted by means of radiating arms to the hemispherical cap 23 and operated by an upward rather than a downward movement in order to open the cyclone 14.

This movement is transferred by a threaded shaft 38, engaged on the hemispherical cap 23 and operated by a handle 39, which screws into a threaded seat in the top wall 17 of the cap 8 which forms a convenient recess for the handle 39.

In Figure 3, the left-hand diametral half-section shows the upper unit of the vacuum cleaner coupled to the lower element with the cyclone 14 closed at the bottom in its normal operating condition.

The right-hand diametral section of the same drawing shows the upper unit 28 separated from the lower element 11, with the cyclone open for emptying.

Alternatively, in order to enable the sleeve 20 to be removed from the cyclone 14, and thus be able to open the bottom of the cyclone 14, the top wall 17 may have a central aperture of suitable diameter, closed by a lid removably fitted to the top wall by either a screw or a bayonet fastening.

The lid itself can act as a deflector like the cap 23 of Figures 1, 2 and 3 and the sleeve would thus be fixed to the lid and removable with it.

It is also possible to connect the lid to the cap 23 by means of an axial screw and nut coupling, so as to enable relative rotation between the lid and the cap 23 along the axis of the sleeve 20.

In a further variant, it is also possible to provide the upper assembly with an openable top lid, with a deflector cap fixed to the lid and removable with it, as well as an upper cyclone and associated sleeve which are fixed

to each other, removably housed in the upper cap 8 and removable therefrom by opening the top lid.

In this case, the dust collected in the upper cyclone can be emptied by turning the upper cyclone upside-down.

This embodiment is illustrated in Figure 6.

In Figure 6 the first conical element 1 forms the first cyclone and is removably engaged in a conical aperture 60 in the lower container 3 which is generally bottle shaped (or shaped like a flask with an elliptical section).

The container 3 is traversed by the axial duct 6 which extends the entire height of the container and the first cyclone.

In this embodiment, the frusto-conical element 1 is fixed to the upper unit 28 and joined to the upper closure cap 8.

The funnel-shape element 13 is arranged inside the frusto-conical element 1 with the funnel-shape element 14 which forms the second cyclone inside the element 13 and the axial sleeve 20 fixed in this case to the element 14.

While the element 13 is fixed to the cap 8, as in the embodiments described earlier, the funnel-shape element 14 and its associated axial sleeve are removable from the cap 8 through a lid at the top 61 which is removably fitted to the cap 8, by a screw or bayonet fitting, for example, or by clips.

The inside of the lid 61 has a flow-guide and deflector 62 around the top of the sleeve 20.

It also has deflectors 63 which deflect and guide the flow of air drawn into the cyclone 14 from outside it, in a direction tangential to its periphery.

The relative positioning of the duct 6, the upper assembly 28 (which in this case also includes the cyclone 1) and the cyclone 14 with its associated sleeve is maintained by the engagement of the sleeve 20 on the duct 6 and by the fact that radial appendages 64 formed in the top of the cyclone 14, rest on an annular abutment 65 formed in the cap 8.

When the cap is closed by the lid 61, the appendages 64 are engaged between the rim of the lid and the abutment 65.

It is thus clear that the container 3 can be separated from the upper assembly 20 for emptying without it being necessary to open or otherwise handle the dust container formed by the cyclone 14 and its associated sleeve 20.

It is clear, on the other hand, that the element 14 can be removed from the upper element 28 for emptying, simply by opening the lid 61, without having to open or otherwise handle the lower container 3.

In order to satisfy the most extreme requirements of cleanliness and hygiene, it is also possible to manufacture a double cyclone vacuum cleaner in which the finer dust trapped by the cyclone 14 is collected in a capsule which can be hermetically sealed by a closure device with no need to open the vacuum cleaner, the capsule remaining closed when the vacuum cleaner is opened

in order to remove the capsule and replace it.

Figure 4 illustrates this arrangement.

In particular, on the left hand side of the diametrical section the vacuum cleaner is shown in its working condition, while the right hand side shows the capsule closed by the closure device.

In Figure 4, the funnel 14 extends to form an inner, coaxial sleeve 41 which engages the axial duct 6 of the lower element 11.

The funnel 14 has a shoulder 42 in its middle portion on which rests a generally semitoroidal outer projection (with corresponding inner recess) of a capsule 43, made of plastics material and generally cup-shaped (formed by blow moulding) with a central duct 55 engageable on the sleeve 41 with one end 50 bent inwardly so as to rest on the end of the sleeve 41 and the duct 6 which both act as supports.

At the top, the funnel 14 extends into a generally cylindrical portion 141 and is closed at the top by a removable lid 44, screw or bayonet fitted to the top of the cap 8.

The lid 44 has an axial hole for receiving an axially movable operating rod 45 which is fixed to a control button 46, outside the lid and to a generally hemispherical cap 47, inside the lid, with its concave face facing the bottom end of the funnel 14.

A capsule lid 48, made of plastics material and generally formed like a hemispherical cup, is housed in the cap 47 under enough pressure to ensure that it is in a stable position, and has an annular rim 49, strengthened, for example by a rolled edge and a bottom 51 shaped into a cylindrical cavity mating with the end 50 of the capsule 43.

Without removing the lid 44, it is possible to push the cap 47 downwards, by exerting pressure on the button 46, so as to force fit the annular rim 49 into the toroidal cavity 52, thus ensuring that the connection is virtually sealed; at the same time, the bottom 51 of the lid 48 is coupled to the end 50 of the central duct 55 of the capsule 43, thus ensuring that the connection is practically sealed and the capsule is closed.

In order to make it easier to close, the cap 47 can have a projection 53 around part of its edge for pushing the rim 49 to engage the toroidal recess 52.

The capsule is closed and sealed effortlessly by turning the button 46, which is specially shaped for turning, at the same time as pressing it.

On the right hand of Figure 4, the capsule is shown in its closed condition.

It is therefore clear that by arranging a capsule 43 in the funnel 14 and a lid 48 in the cap 47, the dust trapped by the cyclone constituted by the funnel 14 accumulates in the capsule which is then closed by its associated lid.

Once it is closed, it is easy to remove the capsule from the cyclone by opening the lid 44.

The capsule can then be removed from the cyclone, either by lifting it by gripping the capsule lid or by turning the upper unit upside-down so that the capsule falls out

by gravity without being handled and can be disposed of in a bin, without the slightest dispersal of dust.

The capsule and its lid can be made cheaply of very thin blow moulded plastics material (or of waterproofed paper) like the plastic cups used in drink vending machines.

In order to enable the user to have a supply of capsules without these taking up too much space, the capsules (and lids) are naturally cone-shaped so that the capsules fit inside each other as do the lids.

In order to remove the coarser particles, collected in the container 3, it is also possible, though not essential, to provide a flexible bag, made of plastics material or paper and specially shaped with a central duct which can be fitted onto the duct 6 and held between the duct 6 and the sleeve 20, while the outer rim of the bag is held between the rim 9 (see Figure 1) of the lower element and the rim 15 of the cap 8.

By separating the lower element from the upper assembly it is possible to partly slide the inner duct of the bag off the duct 6 and to clamp the outer rim of the bag around its central duct with a tie or the like.

The bag can then be removed from the container 3 without the risk of dispersing any particles.

It is clear that while it is preferable to separate the lower element 11 from the upper unit 28 at the top of the funnel-shape body 1 which forms the first cyclone, this can also be done at the base of the funnel-shape body 1.

In Figure 4, the second cyclone is constituted by the cylindrical portion 141 and beneath this by the funnel 14 which has a variable cone shape: being first more and then less accentuated.

By this design, the portion which has a more accentuated cone shape is more effective in capturing dust in the cyclone.

In order to distribute this dust-collecting ability more evenly, it is possible to modify the design as shown in section in Figure 5.

In Figure 5, the funnel-shaped element 14 has the same cone angle up to the level of the intake aperture 18, with the capsule shaped to match.

The lid 48 has an inverted frusto-conical shape with a central crater so that the rim of the crater separates the vortex flow entering the cyclone from the flow exiting towards the duct 6, thereby carrying out the same function as the deflector cap 47 of Figure 4, which may be replaced by a simple disc for pushing the lid 48 towards the capsule 43.

Apart from this structural difference, the embodiment of Figure 5 is entirely the same as that of Figure 4 and thus does not require a detailed description.

Since the lower portion of the cyclone formed by the funnel 14 acts as a storage chamber, it may be convenient, despite a loss of storage space, to make the upper part of the cyclone the most effective in trapping dust, by making it more conical, compared to the lower portion.

Although the above description refers to a vacuum cleaner having two highly effective cyclones in cascade, there is nothing to prevent the first cyclone being constructed as a cylindrical (so-called low efficiency) cyclone, with a further filter being provided at the outlet of the axial duct 6, either a conventional filter cartridge needing to be replaced or cleaned only after prolonged use of the vacuum cleaner or a third, high-efficiency cyclone, separable from the first two.

10 The cylindrical or conical shape of the cyclones does not mean that sections through the axis of the cyclones must be strictly circular.

They may also be elliptical, so as to achieve a compromise between the requirements of the flow and predetermined size limits.

15 In particular, the same criterion applies to the container for the coarser particles, such as the container 3 of Figure 1, which may be elliptical in section or even rectangular or square, conveniently fitted to the cone shape of the cyclone, so as to increase its capacity within the size limits determined in two directions perpendicular to each other and perpendicular to the axis of the cyclones.

25 Claims

1. A cyclone vacuum cleaner for domestic use which includes a first cyclone (1) and a second, coaxial cyclone (14) connected in cascade and suction means (31) for generating a flow of air from an air intake (16) for dust-laden air through said cyclones in sequence,

30 said first cyclone (1) extending downwards into a first container (3) for collecting particles, said second cyclone (14) extending inside said first cyclone (1),

characterised in that

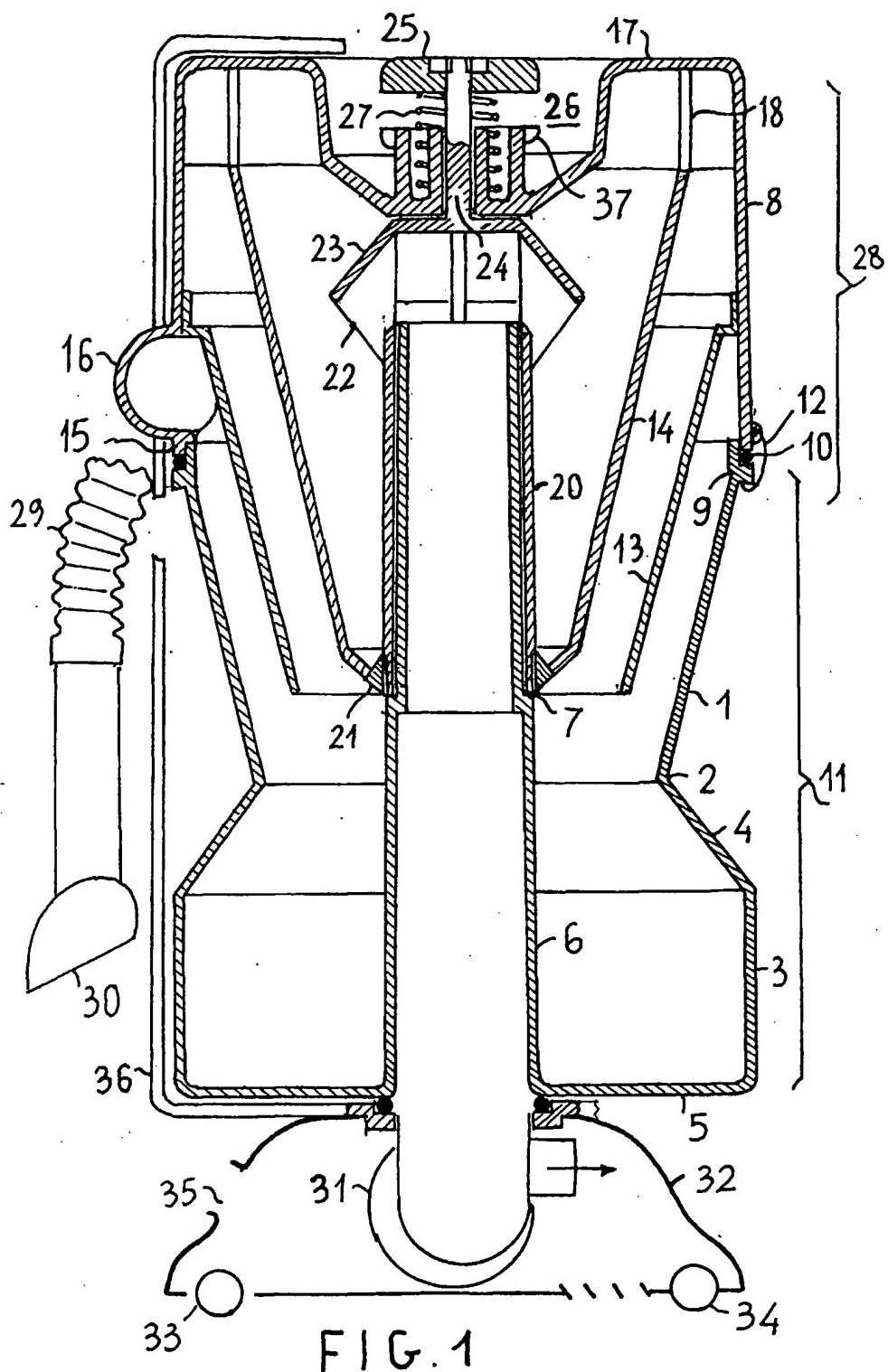
- 40 said first container (3) is traversed by a suction duct (6) coaxial to said cyclones and extending inside said first and second cyclone as far as the top of said second cyclone (14) so as to put this second cyclone into communication with said suction means (31),
- 45 said second cyclone is constituted by a funnel-shape element (14), closed at the bottom by a sleeve (20) which extends coaxially inside said funnel-shape element (14) and is freely engaged in said suction duct (6), said second cyclone (14) being separable from said first cyclone (1) and from said first container (3),

50 55 the lower portion of said funnel-shape element (14) constituting a second dust container separate from said first container (3) and

- said vacuum cleaner includes means

(24,25,38,44,45,46) for opening said second cyclone so as to empty said second container.

2. A vacuum cleaner according to Claim 1 in which said opening means include means (22,23,24,25,38,39) for moving said sleeve (20) axially inside said funnel-shape element (14) from a closed position, in which the bottom of said funnel-shape element (14) is closed, to a position in which said funnel-shape element is open at the bottom, to enable the disposal of dust collected therein. 5
3. A vacuum cleaner according to Claim 2, in which said sleeve (20) has an end collar (21) sealably engaged with the lower end of said funnel-shape element (14) and said moving means comprise a push-button (25) fixed to said sleeve (20) for pushing said collar downwards, moving it away from the lower end of said funnel-shape element. 10 15
4. A vacuum cleaner according to Claim 2, in which said sleeve (20) has one end sealably engaged with the lower end of said funnel-shape element (14) and said moving means comprise a knob (39) acting on a rod (38) coupled to said sleeve (20) so as to urge said sleeve end into said funnel-shape element. 20 25
5. A vacuum cleaner according to Claim 1 in which said opening means include a removable upper lid of said second cyclone, fixed to said sleeve (20). 30
6. A vacuum cleaner according to Claim 1, in which said opening means include a removable upper lid (44) of said second cyclone for inserting and subsequently removing a dust-storage capsule (43), shaped like said second container, said removable upper lid including positioning means (45,46,47,54) operable to position a capsule lid (48) for the capsule (43) inside said second cyclone in one or the other of two positions in which the capsule (43) is open to receive dust collected by said second cyclone or closed to encapsulate the dust respectively. 35 40 45
7. A dust containment capsule for a vacuum cleaner according to Claim 6, characterised in that it includes a container (43) of generally conical cup-shape with a base connected to an axial duct (55), which extends inside said cup and is open at either end, and a closure lid (44) with a rim (49) which can be forcibly engaged in an annular recess (52) of said container and a central recess (51) which mates with one end of said central duct, in such a way that said container is sealed by said lid. 50 55



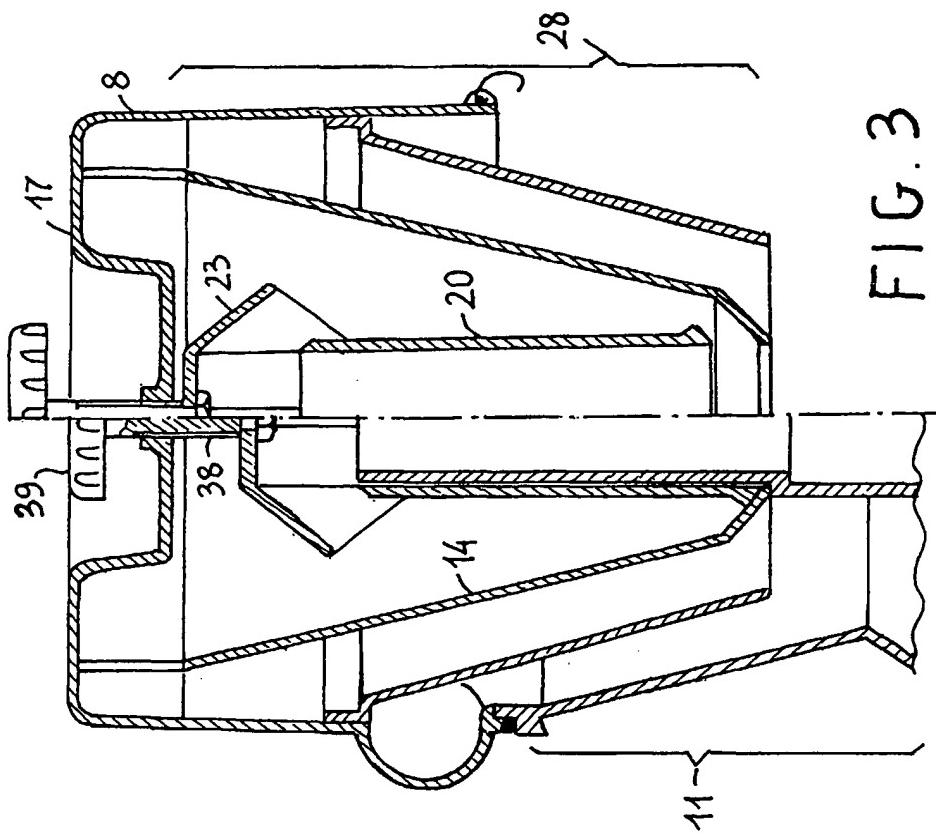


FIG. 3

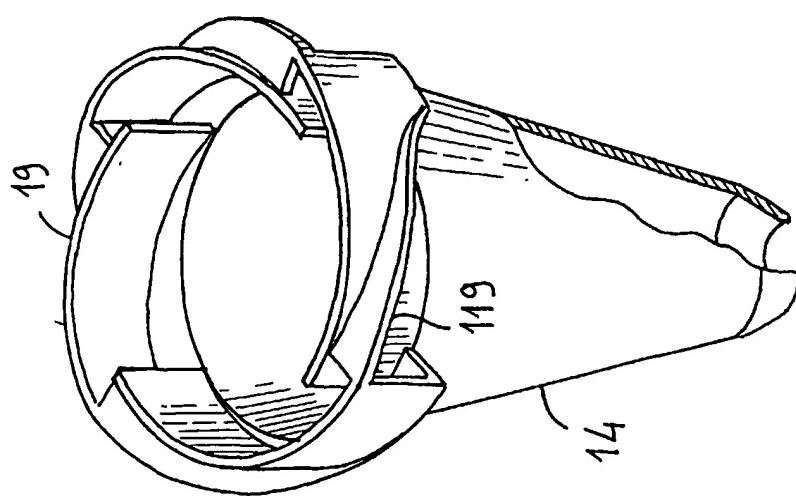


FIG. 2

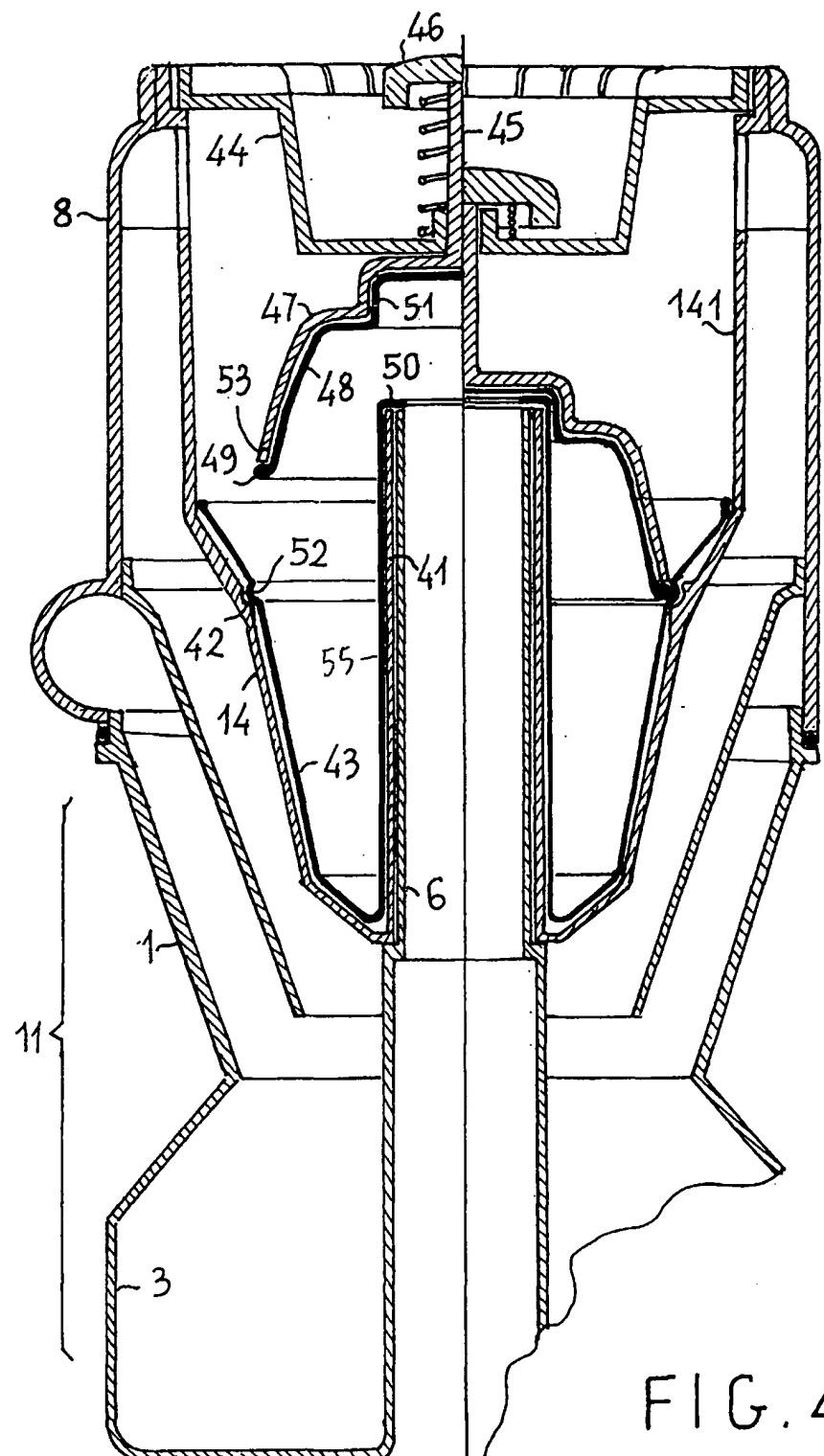


FIG. 4

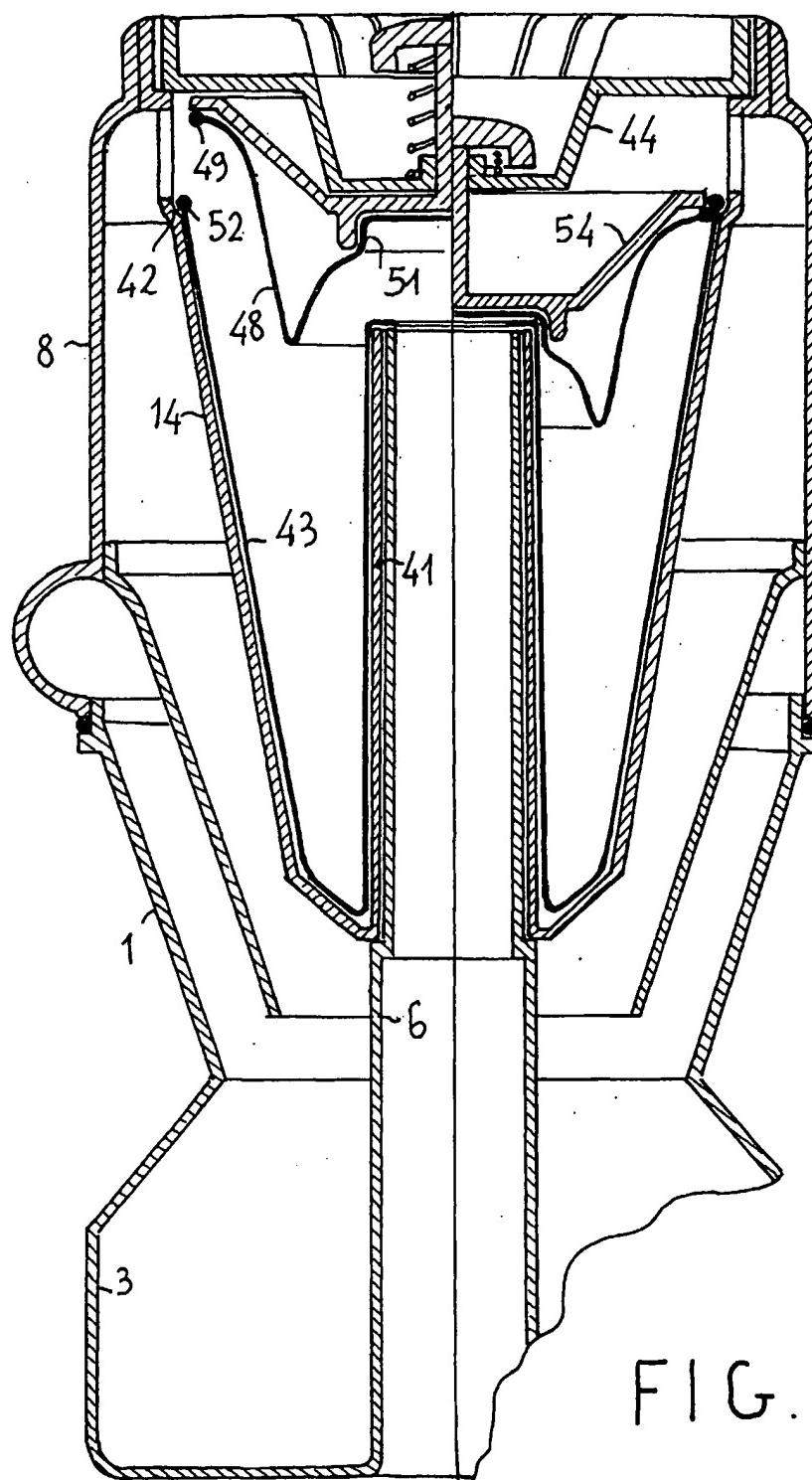


FIG. 5

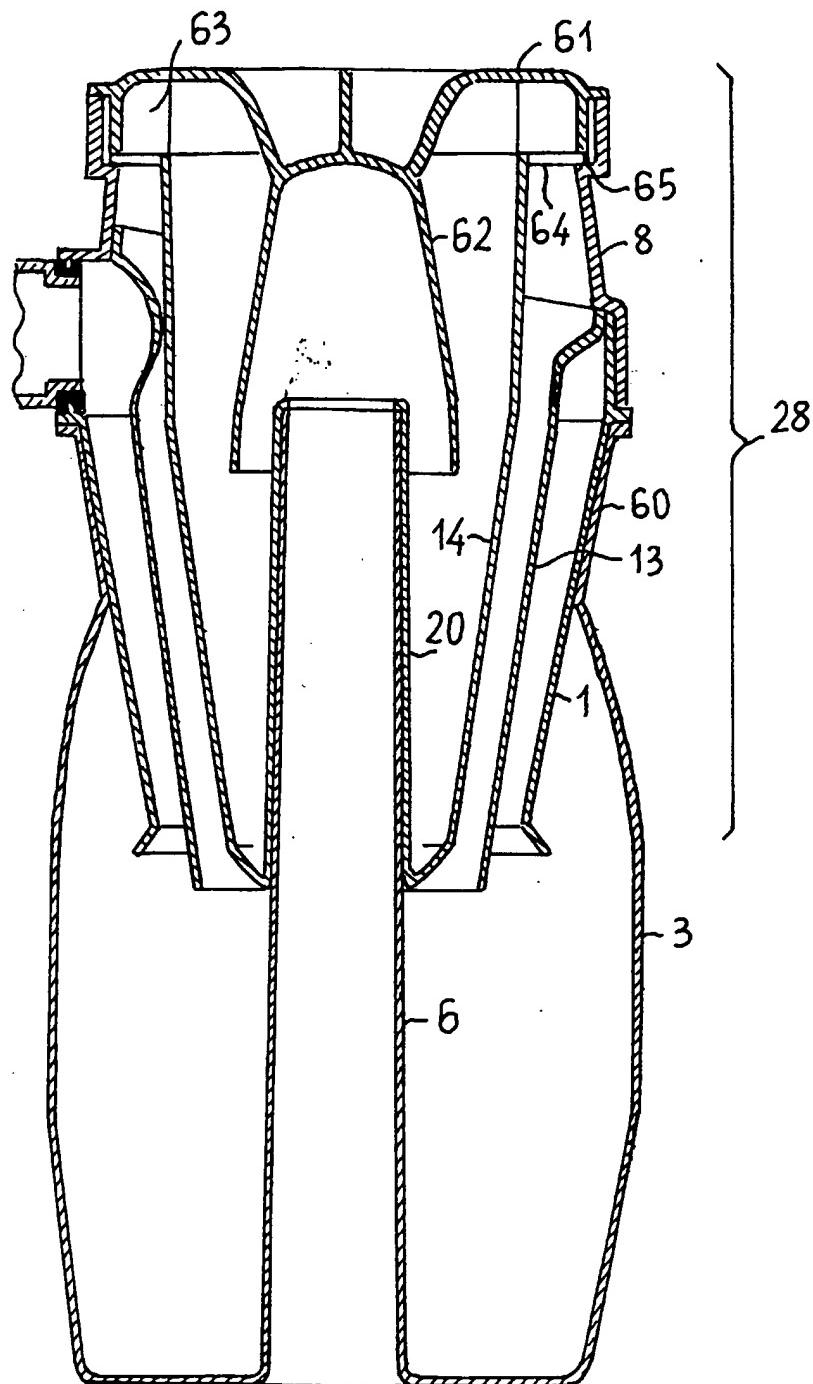


FIG. 6



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0540

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
Y	US 4 853 008 A (DYSON,J.) * column 2, line 50 - column 3, line 51; claim 1; figures 1,4 *	1,2	A47L5/00 A47L9/16
Y,D	US 5 090 976 A (DYSON,J.) * column 3, line 27 - column 5, line 38; claim 1; figures 1,2 *	1,2	
A	---	5,6	
A	EP 0 728 435 A (BLACK & DECKER INC.) *the whole document *	1	
A	CA 978 485 A (GOODINE,C.) * page 3, line 9 - page 6, line 9; claim 1; figures 1-3 *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 95, no. 10, 17 October 1995 & JP 07 265236 A (YOSHIDA YASUNOBU), 17 October 1995, * abstract *	1	
	-----		TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			A47L
<p>The present search report has been drawn up for all claims</p>			
Place of search	Date of completion of the search	Examiner	
THE HAGUE	26 March 1997	Munzer, E	
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
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